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TAXONOMIC NOTES ON THE PTERIDOPHYTES OF HAWAII

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In connection with a projected pteridophyte flora of Hawaii we have published fourteen new species and hybrids (W. H. Wagner 1993). In the present paper we report several additional new taxa as well as a number of combinations required by new developments in our knowledge of these plants and their nomenclature. Type specimens will be deposited at MICH and PTBG, and isotypes at other herbaria, including BISH.

LYCOPODIACEAE

Analysis of the generic classification of Lycopodiaceae shows that there are a number of segregates that should be recognized as genera (cf. Holub 1983; Øllgaard 1987; W. H. Wagner & Beitel 1992). These genera have many distinguishing features, including comparative anatomy, basic chromosome numbers, spore wall structure, and gametophytic morphology. They are separated from each other by strong gaps in many characters, monophyletic uniquely derived states, inability to hybridize *inter se*, and a level of segregation consistent and comparable with modern generic divisions in other pteridophytes. Four of these genera occur in Hawaii: *Palhinhaea* (placed by some authors in *Lycopodiella*), *Lycopodium* s.s., *Huperzia* s.s., and *Phlegmariurus* (also placed in *Huperzia*). *Pseudodiphasium volubile* (G. Forster) Holub has been attributed to the Hawaiian flora, but this seems to have been an error.

One of Hawaii's rarest lycopods, **Phlegmariurus mannii** (Hillebr.) W. H. Wagner, comb. nov. [basionym: *Lycopodium phlegmaria* L. var. *mannii* Hillebr., Fl. Hawaiian Isl. 645. 1888; *Lycopodium mannii* (Hillebr.) Skottsb., Acta Horti Gothob. 15: 131–132. 1942] is apparently known only from the islands of Hawaii, Maui, and Kauai. It tends to grow on rough-barked trunks and boughs of trees, and is easy to overlook. This species is very similar to certain members of a tropical American group designated by Øllgaard (1987) as the subgroup of *Huperzia myrsinites* (Lam.) Trevisan. He gives its range as "Tropical America, Hawaii." **Phlegmariurus nutans** (Brack.) W. H. Wagner, comb. nov. [basionym: *Lycopodium nutans* Brack., U.S. Expl. Exped. Filic. 16: 327, t. 46. 1854; *Huperzia nutans* (Brack.) Rothm., Feddes

Repert. Spec. Nov. Regni Veg. 54: 62. 1944] is a rare and local species of special interest because of its sporangium-bearing tassels that are considerably less differentiated than in most members of the *Phlegmaria* group. Reported only from Oahu and Kauai, it is best known from the Koolau Mountains of the former island. Other new combinations needed are the following: **Phlegmariurus filiformis** (Sw.) W. H. Wagner, comb. nov. [basionym: *Lycopodium filiforme* Sw., J. Bot. (Schrader) 1800(2): 114; synonym: *Lycopodium polytrichoides* Kaulf., Enum fil. 6. 1824].

Of the ten Hawaiian members of the gemmiferous fir-moss genus, *Huperzia*, five are sterile hybrids. The latter are evidently capable of dispersal by modified deciduous shoots or gemmae that resemble samaras and are probably dispersed by wind. New collections are much needed. For example, there is a peculiar taxon on Kauai that resembles *H. serrata* (Thunb. ex Murray) Trevisan, but has smaller leaves with smooth margins and conspicuous "petioles"; it needs further investigation.

GLEICHENIACEAE

Two species of *Dicranopteris* have traditionally been recognized in Hawaii. The glabrous one, "uluhe," *D. linearis*, is one of the most abundant fern species in the islands. It occurs usually in open, disturbed places, where it forms often extremely large beds that are hard to penetrate because of the numerous criss-crossing rachises. The ferruginous, woolly one, generally treated as *D. emarginata*, is much less common. In our experience, most of the differences alleged to characterize the two species are invalid. The only striking difference, that involving the presence or absence of pubescence, is highly unreliable, because all intermediate states are found. For this reason we regard the pubescent extreme as only a form, as follows: **Dicranopteris linearis** (N. Burm.) Underw. f. **emarginata** (Brack.) W. H. Wagner, comb. nov. [basionym: *Mertensia emarginata* Brack., U.S. Expl. Exped. Filic. 16: 297. 1854; *Dicranopteris emarginata* (Brack.) W. J. Robinson, Bull. Torrey Bot. Club 39: 240. 1912].

HYMENOPHYLLACEAE

Of the ten species of filmy-ferns in Hawaii, one (a *Gonocormus*) is known in Hawaii only from the islands of Maui and Hawaii, and one (a *Vandenboschia* here described) is known only from Kauai. All of the others are more widespread.

The genus *Callistopteris* produces the most abundant gametophytes in Hawaii, according to D. R. Farrar. The local species is not sufficiently different to warrant its separation from *C. baueriana* (Endl.) Copel., originally described from Norfolk Island but now known to have a wide distribution. It is remarkably variable in Hawaii and traditionally has been identified as *C. baldwinii* (D. C. Eaton) Copel., based on original material found by D. D. Baldwin in 1878 in a valley on Oahu. In 1987 Farrar discovered a colony of plants, indistinguishable from the type (NY!), growing on mossy banks along the Upper Palolo Valley Trail. The only character that we can find to separate the type collection of *C. baldwinii* and the Farrar collection from the common Hawaiian plants, assigned to *C. baueriana*, is size; *C. baldwinii* reaches only 15 cm in height in contrast to *C. baueriana's* 55 cm. A more difficult taxonomic problem involves an element that occurs on Kauai. It is possible that it represents a distinct species, but there are intermediates. The following key will separate the two extremes.

Plants terrestrial; fronds upright, up to 55×15 cm; stipe usually straight at base and the rachis also straight; blade 3–4-pinnate; the segments 0.2–0.8 mm wide; involucres 0.9–1.2×1.0–1.3 mm. "Extreme 1": Segments narrow, sorus small (throughout the islands).

Plants on vertical moss-covered banks; fronds appressed, up to 15×9 cm; stipes usually bent at base and more or less twisted in upper part; blade 2–3-pinnate, the segments 0.4–1.1 mm wide; involucres mostly 1.3×2.2 mm. "Extreme 2": Segments broad, sorus large (Kauai only).

The most illustrative specimens of "Extreme 2" were found in the first large stream valley on Kilohana Trail beyond the end of the road (tributary of Kawaikoi Stream) in the Na Pali-Kona Forest Reserve, on vertical shaded mossy rock stream banks with *Sadleria unisora*, *Dryopteris tenebrosa*, and *Huperzia serrata*, 18 Aug 1947, *W. H. Wagner 5579* (MICH).

The following new species is known only from Kauai and until now apparently was confused with the similar filmy-fern *Vandenboschia davallioides* (Gaud.) Copel.

Vandenboschia tubiflora F. S. Wagner, sp. nov. Fig. 1.

Vandenboschiae davallioidi similis sed frondibus linearibus vel lineari-lanceolatis, lamina pallido-viridi, indusio tubulari basi truncato medio maxime dilatato orificio non vel minime expanso.

Creeping and climbing fern of the rain forest. Rhizome surficial long-creeping, 2–4 mm thick and covered with deciduous black and shiny appressed hairs, these up to 2 mm long, the upper 1 mm spreading. Roots few, small, 0.5–2.0 cm long and very narrow, arising near the leaf bases. Fronds linear to linear-lanceolate, up to 45×20 cm, 2–3-pinnate. Petiole 0.1–8.0 cm, narrowly winged, green, lacking trichomes. Rachis narrowly winged. Lamina 1 cell thick between veins, pale to medium green. Pinna pairs 16–23. Medial pinnae linear to linear-lanceolate, 3.5–5.0 times as long as wide, up to 7.5×1.5 cm. Basal pinnae reduced to 1/2–1/4 the length of medial pinnae. Pinnules lobed, the larger lobes apically cut into 2–5 narrow to very narrow projections. Venation free. Sorus marginal, arising singly on basal anterior segments of the pinnules. Paraphyses 0.8–1.2×0.4–0.7 mm. Indusium tubular, truncate, narrow at base, widening to maximum width in middle, not or only slightly flared at opening, sometimes inconspicuously 2-lipped.

HOLOTYPE: Kauai, Alakai Swamp Trail, 3700 ft, common on tree trunks in wooded areas, growing as a vine, 19 Jun 1964, *M. R. Crosby & W. R. Anderson 1484* (MICH).

ADDITIONAL SPECIMENS EXAMINED. KAUAI: Halemanu, 14–26 Feb 1907, *J. F. Rock 2277* (BISH). Lihue-Koloa Forest Reserve, nw of Wahiawa Bog along tributary of Wahiawa Stream, nw of stream and se of Hulua, wet forest dominated by *Metrosideros, Antidesma, Cyrtandra,* and *Athyrium*, epiphytic, 650–730 m, *T. Flynn et al. 2915* (BISH, PTBG). Kauhao, 800 m, *Faurie in 1910* (MICH). Hanapepe Falls, 300 m, *P. C. Hutchison 7340 & G. S. Daniels* (BISH, NY). Waiole Valley, *Forbes 95* (MICH). Waimea Drainage Basin, w side, Kauaikinana, *C. N. Forbes 1005,K* (BISH). Along Alakai Swamp Trail, 3700–4000 ft, 27 Oct 1956, *B. C. Stone 1514* (BISH); Kokee State Park, Kalua Puhi Trail, locally abundant, 28 Jul 1992, *W. H. Wagner 92131* (MICH).

The species dealt with here are commonly placed in the genus *Trichomanes* s.l. *Vandenboschia tubiflora* and *V. davallioides* correspond fairly closely with the New World tropical species pair, *Trichomanes* (*Vandenboschia*) *collariatum* van den Bosch [=*V. martinezii* (Rovirosa) Pichi Sermolli, *Trichomanes martinezii* Rovirosa] and *T.* (*V.*) *radicans* Sw. (cf. Mickel & Beitel, 1988, pp. 391, 395); the former has a flared indusium and the latter a truncate indusium. Vegetatively they are rather similar, but a complete resolution of their taxonomy must await a world-

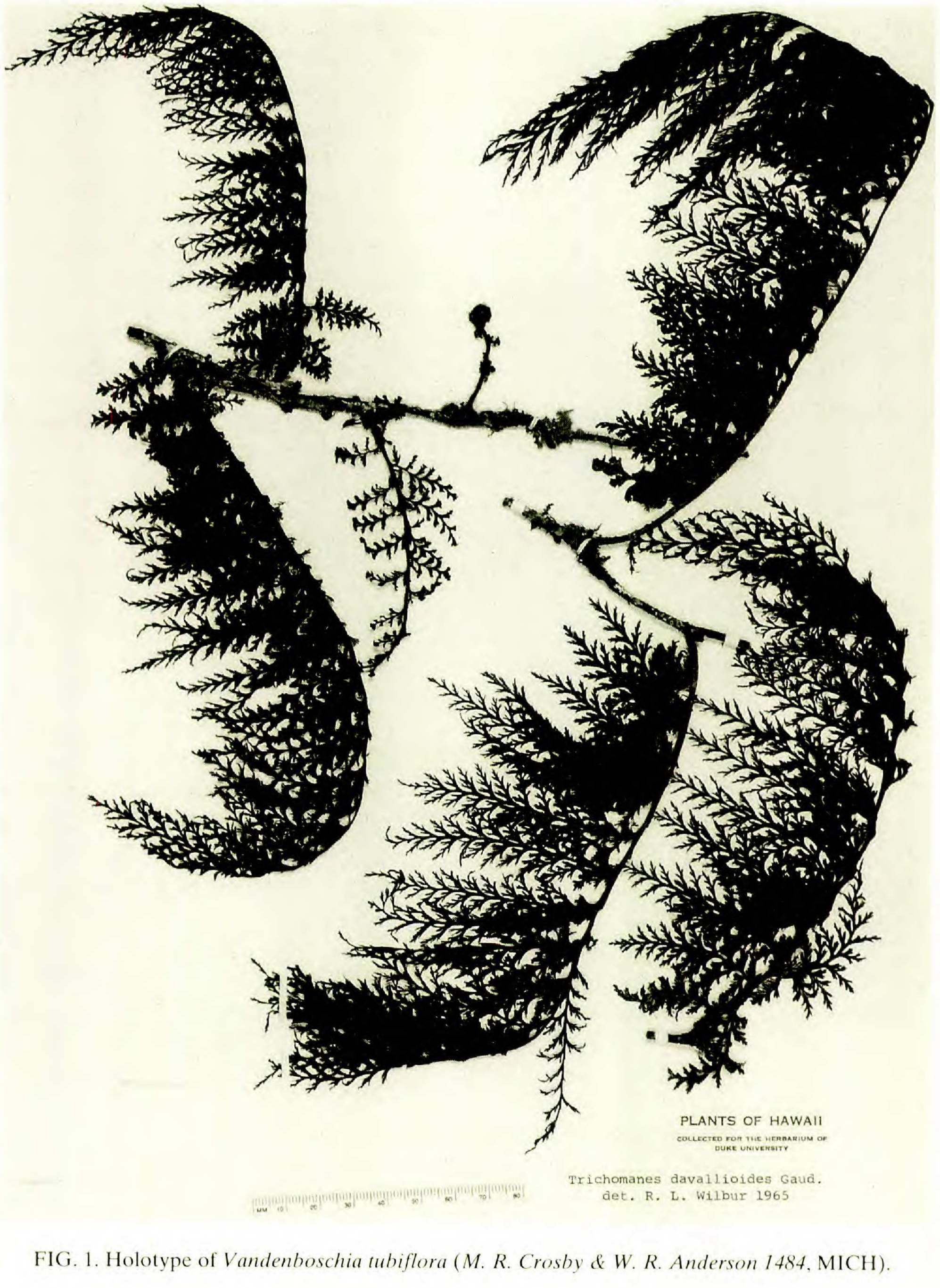

FIG. 1. Holotype of *Vandenboschia tubiflora* (*M. R. Crosby & W. R. Anderson 1484*, MICH).

level monograph. *Vandenboschia radicans* (Sw.) Copel. is an almost worldwide tropical and subtropical species with many local variations; however, those specimens that we have seen appear to be coarser, with broader segments, than *V. tubiflora*. The two representatives of this group native to Hawaii may be readily separated as follows.

Indusia tubular, not or only slightly flared at apex; fronds mostly linear to linear-lanceolate; middle pinnae mostly 3.5–5.0 times as long as wide; Kauai. *V. tubiflora.*

Indusia tubular but conspicuously flared at apex, the flared portion 1.4–2.0 times the width of the tube; fronds mostly narrowly lanceolate to lanceolate-ovate; middle pinnae mostly 2–3 times as long as wide; on all the islands. *V. davallioides.*

THELYPTERIDACEAE

The most common and conspicuous maiden fern in the Hawaiian islands is *Thelypteris cyatheoides* (Kaulf.) Fosberg. It is also one of the most variable species, difficult to segregate from its sister species. Within the *cyatheoides*-species-complex, habitats vary from flat forest floors to steep wooded hillsides, to vertical rock walls in the spray of waterfalls, to exposed shelves and crevices of rocks along streams. The rhizomes may be erect, climbing, or creeping, and vary in thickness from population to population, from less than 0.5 cm to 6.5 cm (including the armor of leaf bases on upright rhizomes). The color of the stem tissues is usually whitish or yellowish but may be bright purple. Rhizome scales may vary from linear to broadly lanceolate, and they may persist or be shed. Fertile frond length ranges from 5 to 200 cm. The axes may be scaly or glabrous. Pinnae vary from 0.8–4.5 cm in width; their shape may be lanceolate to linear, non-falcate to falcate. Veinlet pairs connected to the sinus vein may range from 1–10. The pinna margins may be cut into lobes 0.3–2.5 cm long or they may be entire. The basal pinnae may be unreduced or reduced when compared to the adjacent, more distal ones. The rachis may be nearly round on top to rather conspicuously sulcate. The veins and the lamina may be hairy or glabrous, and, if present, the hairs may be long or short. Golden glands are found in some populations, absent in others. The indusium may be absent or nearly absent or fully developed. If the last, it may be reniform or peltate, smaller than or larger than the mature sorus.

In the face of the enormous variability of the common *T. cyatheoides*, many factors must be recognized in designating species, among them the ability to grow with or near sister species, and the constancy and distinctness of characters and character complexes. The dwarf species *T. boydiae* (D. C. Eaton) Iwats., known thus far only from Oahu, Maui, and Hawaii, inhabits rocky places along streams. Hillebrand regarded it a variety of *T. cyatheoides* (var. *depauperatum* Hillebr., 1888). Holttum (1977) upheld it tentatively as a species but recommended its further study. *Thelypteris cyatheoides* also hybridizes with the naturalized *T. dentata* (Forsk.) E. P. St. John and forms the confusing sterile hybrid *T.* ×*palmeri* W. H. Wagner (1993). The hybrids occur widely on Oahu, but we have found so far only a single population on Kauai, a large population with perhaps a hundred individual plants over an area of ca. 6×6 m.

We also report two new species of *Thelypteris* here, both apparently endemic to Kauai. A key to the *T. cyatheoiodes*-complex is provided below.

Thelypteris exindusiata W. H. Wagner, sp. nov.

Thelypteridi cyatheoidi similis sed rhizomate longi-repenti purpureo-brunneo parenchymate purpurascenti, indusio vestigiali in soro vix visibili.

Thelypteris exindusiata is a large coarse fern resembling *T. cyatheoides* but differing from it usually in the following characters: rhizome purplish brown with purplish parenchyma, long-creeping and forming large clones; pinnae up to 25 pairs, nearly to entirely sessile, thin chartaceous; veins glabrous, hairy, or glandular; indusium vestigial so as to provide little or no protection and usually hardly or not visible.

HOLOTYPE. Kauai, Kealia Forest Reserve, along Makaleha Stream, locally abundant in shaded woods between trail and stream, 200 m, associated with *Deparia marginalis*, 27 Jul 1992, *W. H. Wagner et al. 92110* (MICH).

ADDITIONAL SPECIMENS EXAMINED. KAUAI: Wainiha Valley, stream below Hono-o-na-pali, on ground in *Hibiscus tiliaceus* thicket, 50 m, 31 Dec 1952, *K. A. Wilson 226* (BISH). Kipu, Haupu (Hoary Head Mts), wooded moist gulch, steep wooded slope, 215 m, 25 Dec 1933, *H. St. John & F. R. Fosberg 13648* (BISH). Wahiawa Mts, *C. N. Forbes 239K* (veins hairy; 3 sheets BISH). Haiku (Hoary Head Mts), Laaukahi, 400 m, on precipitous slope, 22 Dec 1933, *H. St John & F. R. Fosberg 13490* (BISH).

In general this is a species of low elevations, around 200 m. Thus far, we have not seen it growing side-by-side with *T. cyatheoides*, although such an association is to be expected.

Thelypteris wailele T. Flynn, sp. nov. Fig. 2.

Cataractas incolens; frondes angustae pendulaeque; pinnae basi truncatae, ascendentes, margine parum crenatae, apice longi-acuminatae; venae 1–3 paria per segmentum; indusia quam sori minora.

Plants epipetric near waterfalls. Rhizome slender, 2.5–4.0 mm in diameter (dry). Stipe dark brown at base, pale green above, 5.5–18 cm long. Lamina linear-oblanceolate, narrowed at the base with 1–4 pairs of reduced pinnae, 7.5–32 cm long, 3.8–13 cm wide. Pinnae with base truncate, lobed acroscopically, the margin shallowly crenate, apex long acuminate. Costules 2.5 mm apart, veins 1–3 pairs; both sides glandular; margin, veins and costules with linear-oblanceolate scales to subglabrous to glabrous. Sori subcostal to medial at base of pinnae; indusia round, sub-peltate to reniform with few to several scales.

HOLOTYPE: Kauai, Hanalei District, Waioli Valley, on sheer rock face in spray of waterfall, 457 m, 5 Nov 1992, *T. Flynn, D. Lorence & S. Perlman 5130* (PTBG; isotypes: BISH, MICH, US, Palmer Herb.).

ADDITIONAL SPECIMENS EXAMINED. KAUAI: Waioli, back of valley below Namolokama, 439 m, 4 Nov 1992, *S. Perlman et al. 13096* (PTBG) (this collection is from the type locality). Hanging valley above main falls, 550 m, 19 Nov 1993, *K. R. Wood 2141* (MICH, PTBG); 23 Jul 1909, *C. N. Forbes 84K* (BISH). Wainiha, back of valley below Hinalele Falls, 770 m, 29 Jan 1993, *K. R. Wood et al. 2334* (PTBG). Hanalei, back of valley below Pohakupele, headwaters of the Hanalei River, 620 m, 22 Mar 1993, *K. R. Wood 2445* (PTBG); on sheer, dripping wet walls at back of valley along waterfall, 713 m, 22 Mar 1993, *T. Flynn 5319* (AD, BISH, MICH, PTBG, US). Waimea District, Koaie Canyon, 3080 ft, 31 Aug 1994, *K. R. Wood & S. Perlman 3461* (BISH, MICH, NY, PTBG, US).

The epithet for this species is the Hawaiian word for waterfall and refers to the habitat, usually on a sheer rock face, at the margins of falls in the spray zone. This rather striking fern is easily recognizable by its narrow, pendent fronds and slender, creeping rhizome. It was first collected in 1909 in Waioli Valley on the north shore of Kauai by C. N. Forbes, and then not again until 1992 in the same valley.

KEY TO THELYPTERIS CYATHEOIDES COMPLEX

1. Mature fronds up to 1 m or more long; soriferous pinnae up to 8–15 cm long; rachis 2–5 mm thick.
   2. Rhizome and lower stipe surface straw-colored (alive); internal parenchyma cells white to yellowish; pinnae up to 35, short-stalked (up to 1 mm), coriaceous; indusium conspicuous, usually covering sorus; occurring on all the islands, morphology highly variable.

T. cyatheoides.

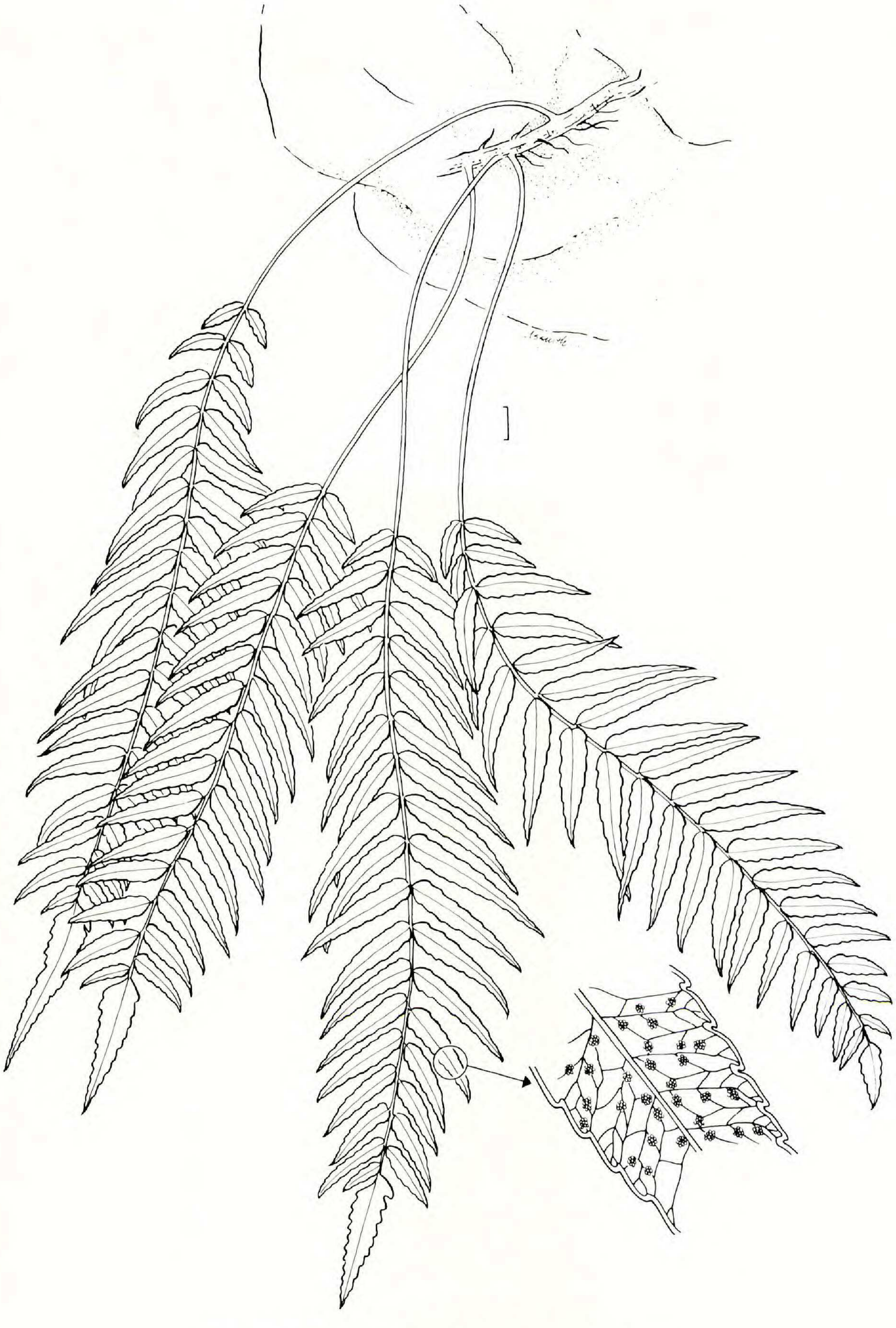

FIG. 2. *Thelypteris wailele*, based on the holotype.

2. Rhizome and lower stipe surface purplish brown, internal parenchyma cells purplish; pinnae up to 25, nearly sessile, chartaceous; indusium vestigial, in mature sori usually not apparent to the naked eye; Kauai, locally common at lower altitudes, morphology uniform. *T. exindusiata.*

1. Mature fronds mostly less than 0.5 m long; largest soriferous pinnae 3.5–7 cm long; rachis 0.8–1.4 mm thick.

3. Fronds stiffly upright; rhizome erect; middle and upper pinnae tips rounded, ending more or less abruptly, weakly ascending; indusia broader than sori; Oahu, Maui, Hawaii, on rocks and ledges along streams. *T. boydiae.*
3. Fronds loosely pendent; rhizome long-creeping; middle and upper pinnae ending in long-attenuate tip; strongly ascending; indusia only 1/2–2/3 as broad as sori; Kauai, on sheer rock faces at the margins of falls in the spray zone. *T. wailele.*

ASPLENIACEAE

The genus of spleenworts, *Asplenium* s.l., is the largest in number of species (a total of 20 varieties and sterile hybrids are excluded) of all the Hawaiian fern genera. Worldwide, the genus is credited with approximately 600 species, and a number of small related but very distinct genera have been amalgamated with it over the past 50 years. The genus is noted for the capacity to produce interspecific hybrids, including many between morphologically very different parents. It is also noted for its sometimes very subtly differentiated species. Occasionally striking sporadic forms appear, especially ones with unusually divided fronds.

The genus *Diellia* Brack. is one of the most interesting groups in the islands due to its extreme variability and the great rarity of most of its species. It was recently reduced to synonymy under *Asplenium* L. by R. Viane (Viane & Reichstein 1992). However, along with several other groups of *Asplenium* s.l., we believe that *Diellia* merits generic recognition. One of its species, as we construe it, is prototypic in the sense that its sori are not submarginal and pointing outward; however, all of its other characters coincide closely with those of the other species, and for this reason we propose the the following new combination: **Diellia leucostegioides** (Baker) W. H. Wagner, comb. nov. [basionym: *Asplenium leucostegioides* Baker, Ann. Bot. 5: 302. 1891]. It was found in East Maui before 1879, but has not been collected since, although it may still occur there. It may possibly be confused with *Asplenium normale* Don unless examined carefully. The characters that are shared by all the species of *Diellia* are the entire-margined pinnae, sessile and overlapping the rachis, the widely spaced veins, the short sori (except for partially fused coenosori in some species), and the peculiar, appressed, apparently unique two-celled gametophytic trichomes. There is no question that all six of the species now included in *Diellia* are monophyletic.

In Kauai, one of the spectacular endemics, the feathery, highly divided *Diellia mannii* (D. C. Eaton) W. J. Robinson, has apparently not been collected since the last century. A note in the Bishop Museum from A. S. Knudsen in 1914 reads, "*Diellia mannii* very rare. It has all disappeared from the Halemanu Mountains." Nevertheless, considering their recent good fortune in rediscovering other rarities, field botanists should keep this fern in mind. The other Kauai endemic, *D. pallida* W. H. Wagner (1993) [formerly misidentified as *D. laciniata* (Hillebr.) Diels], still exists in two small populations, one in Koai'e Canyon, 4 plants, at ca. 600 m in bare soil on a steep slope with *Antidesma, Electryon, Rauvolfia, Melia, Acacia koa,* and *Lantana* (*Lau 3100* in 1987, BISH). The other population is in Mahanaloa Valley at ca. 670 m on the trail from Milolii Ridge into Paaiki Valley and into Mahanaloa, under a canopy of *Diospyros* and *Pisonia*, on sloping dry rocky terrain, 10 plants, 10 July 1991, *J. Obata & S. Perlman s.n.* (BISH). Considering its rarity every effort should be made to preserve its habitats. All except one of the six *Diellia* species are known only from single islands: Kauai, *D. mannii* and *D. pallida*; Oahu, *D. falcata* Brack. and *D. unisora* W. H. Wagner; and Maui, *D. leucostegioides*. Only *D. erecta* is found on all the high islands.

Following are two new taxa of *Asplenium*, one a fertile orthospecies, the other a sterile nothospecies.

Asplenium neobrackenridgei W. H. Wagner, sp. nov. Fig. 3.

Asplenium contiguum Kaulf. var. *hirtulum* C. Christensen, Bernice P. Bishop Mus. Bull. 25: 27. 1925 (holotype: unknown).

Asplenio contiguo similis, sed squamis rhizomatis tegentem brunneam lanatam formantibus, segmentis anticis pinnae subtiliter serrulatis, pinnis versus apicem gradatim angustatis, lamina axibusque pilis glandulosis eglandulosisque dense tectis, 1–4 cellulas longis.

HOLOTYPE: Kauai, Kokee, Pihea Trail, 9 Apr 1987, *W. H. Wagner 87180* (MICH).

ADDITIONAL SPECIMENS EXAMINED. KAUAI: Robinson summer home, 800 m, 1910, *L. Faurie 315* (CA). Pihea Trail from Puu o Kila to Alakai Swamp Trail, terrestrial along trail in swamp, 14 Aug 1992, *J. Montgomery 9294* (private collection). Island not stated: Standard Species ex Herb D. D. Baldwin, Kokee, Pihea Trail, 9 Apr 1987 (MICH).—MAUI: East Maui, middle Waikamoi Forest along road to flume trail, common on mossy tree trunks, with eglandular form, all stages juvenile to adult, ca. 1300 m, 27 Mar 1987, *W. H. Wagner 87155a* (MICH).

The following key compares it with the sister species *A. contiguum.* The first lead also serves as the English description of *A. neobrackenridgei.* It may grow together with or nearby *A. contiguum*, allowing comparisons to be made in the living state. Intermediates are unknown.

Basal scales forming a medium brown woolly mass; anterior pinna segments finely dentate-serrulate, the teeth mostly narrowly pointed; pinnae with mostly gradually narrowed tips; lamina and axes densely covered with glandular and non-glandular hairs, 1–4 cells long; sori 2–7 mm long; Kauai and Maui, in rain forests, rare and local. *A. neobrackenridgei.*

Basal scales forming a dark brown to nearly black flat imbricate mass; anterior pinna segments dentate, the teeth mostly rounded; pinnae mostly with long-acuminate narrow tips; lamina and axes glabrous except for scattered fibrils; sori 4–10 mm long; occurring on all islands, in dry to wet forests, common and widespread. *A. contiguum.*

Asplenium ×kokeense W. H. Wagner, hyb. nov. Fig. 4.

Inter *A. aethiopicum* et *A. cookii* intermedia; rhizoma repens; squamae usque ad 6 mm longae; frons usque ad 80 cm alta, (1–) 2-pinnata; pinnae anguste triangulares; pinnulae basales late acutae; lamina margine dentata vel grosse serrata; sporae abortivae.

Intermediate between A*splenium aethiopicum* (N. L. Burm.) Becherer [synonym: *A. praemorsum*] and *A. cookii* Copel. (in Hawaii the name *A. polyodon* has been misapplied to the latter species). Rhizome creeping, the scales ± 6 mm long. Frond to 80 cm tall, 1–2-pinnate. Pinnae narrowly triangular, the basal pinnules broadly pointed, the margins variable from broadly dentate to coarsely serrate. Spores abortive.

HOLOTYPE: Kauai, Kokee, Waineke Swamp, one huge sterile clone growing at weedy swamp edge with parents, 11 Apr 1987, *W. H. Wagner 87198* (MICH).

ADDITIONAL SPECIMEN EXAMINED. OAHU: Waianae Mts, Makaha–Waianae Kai, Puu Kaawewe–Puu Kaala Ridge, 31 Mar 1935, *F. R. Fosberg 10846* (BISH).

This nothospecies will probably be revealed to have many more populations. The parents, especially *A. cookii*, are common, and once formed the hybrid is

FIG. 3. Holotype of *Asplenium neobrackenridgei* (*W. H. Wagner 87180*, MICH).

FIG. 4. Holotype of *Asplenium ×kokeense* (*W. H. Wagner 87198*, MICH).

capable of producing large and vigorous clones. The following key will separate the hybrid from the parents.

1. Fronds mostly 1-pinnate; secondary segment tips crenate (when present); basal segments linear to linear-rhomboidal; spores normal. *A. cookii.*
1. Fronds mostly 2-pinnate; secondary segments tips irregularly dentate to deeply incised; basal segments rhomboidal to subflabellate; spores normal or abortive.
   2. Middle and upper pinnae pinnate 3–5 times as long as broad; segments narrowly rhomboidal, distally crenate to dentate or serrate, not or slightly cleft. *A. ×kokeense.*
   2. Middle and upper pinnae 1 1/2–2 1/2 times as long as broad; segments subflabellate, distally deeply serrate, usually more or less cleft. *A. aethiopicum.*

DRYOPTERIDACEAE

A number of Hawaiian fern species are noted for unusual soral arrangements that deviate considerably from those in related species. There seems to be a strong tendency toward marginward migration of the sori (e.g., *Grammitis baldwinii* vs. *G. hookeri*, *Diellia erecta* vs. *D. leucostegioides*, *Dryopteris parvula* vs. *D. glabra*). More striking is the tendency for the sori to become stalked, e.g., marginally, *Deparia prolifera* stalked vs. non-stalked forms of the same species, and, dorsally, *Dryopteris soripes* vs. *D. glabra*. The most remarkable stalked-sorus species as yet found in Hawaii is a newly discovered one that occurs on steep, mossy walls of rain forest stream valleys near the Alakai Swamp in Kauai. In this previously undescribed species the sori are dorsal but stalked, the stalks 0.8–1.3 mm long. When the living frond is lightly shaken the sori jiggle. The most similar soriation known to us is that of species of the genus *Peranema*, which ranges from India to Malesia (cf. *P. cyatheoides* Don, Kramer, p. 109, fig. 48J). The new species appears grossly like a young *Cibotium* growing from a nearly vertical mossy wall. Its nearest relative is apparently *D. crinalis,* and its description is given in table 1 comparing them. The new species is very rare, and every effort should be made to preserve this remarkable fern. The right-hand column in the comparison chart below will serve as the English description.

Dryopteris podosora W. H. Wagner & T. Flynn, sp. nov. Fig. 5.

Dryopteridi crinali similis sed stipite pinna 2–3plo breviore, lamina plerumque 2-pinnata, venulis infernis segmentorum plerumque 1–2-ramosis, soris exindusiatis globularibus stipitatis stipitibus 0.8–1.3 mm longis.

Holotype. Kauai, Waimea District, Kauaikinana Stream, W of Pihea Trail, Alakai Swamp Trail, shaded wet mossy wall above stream, 28 Jul 1992, *W. H. Wagner 92115* (MICH).

Additional Specimens Examined. Kauai: Kauaikinana Stream W of Pihea Trail (type locality), 28 Jul 1992, *T. Flynn et al. 5091* (BISH, PTBG). 200 m from Alakai Swamp Trail crossing stream from Mohili Stream, steep, dark, damp slope, with *Sadleria unisora, Cibotium glaucum*, and *C. menziesii*, 16 Nov 1992, *D. D. Palmer & T. Flynn 1026* (Palmer Herb.)

Dryopteris parvula W. J. Robinson (1912) is a nomen novum based on *Aspidium glabrum* var. *pusillum* Hillebr., Fl. Hawaiian Isl. 577. 1888. The name *Dryopteris pusilla* was preoccupied by *Dryopteris pusilla* (Mett.) Kuntze. The original plants of *D. parvula* were collected on "Kauai. 5000–6000 ft. (Kn[udsen] and E. Johnson)" according to Hillebrand (1888). Except for Robinson, all authors have apparently

Table 1. Comparison between *Dryopteris crinalis* and *D. podosora.*

	D. crinalis	*D. podosora*
Habitat	wet shaded slopes and banks	steep dark mossy walls
Frond orientation	mainly pendent	upright, spreading (like juvenile *Cibotium*)
Stem	short, upright	short, upright
Scales	0.4–1.5×0.2–1.0 cm	0.3–1.2×0.04–0.8 cm
Fibrils along axes	blackish, extremely narrow, only 0.05–0.1 mm wide; mostly 1–2 cells wide in outer half; bases not strongly dilated; cells linear	brown, narrow, mostly 2–5 cells wide in outer half; bases commonly strongly dilated; cells oblong to square
Blade	attenuate deltate; 15–45×7–28 cm; 8–12× as long as wide	elongate deltate; 12–35×7–26 cm; 2–8× as long as wide
Stipe	mostly 1/4–1/3 as long as blade	mostly 1/2–1/3 as long as blade
Blade cutting	2–3-pinnate	2(–3)-pinnate
Apical lobes	rounded or slightly toothed	angular with apical low cartilaginous teeth
Lower veinlets on segments	mostly 0–1-branched	mostly 1–2-branched
Costal trichomes	black, linear, few linear cells wide	mostly reddish brown, triangular, attenuate, many elongate-oblong cells wide
Sori	dorsal, hemispherical, not stalked	dorsal, globular on narrow non-chlorophyllous vascularized stalks 0.8–1.3 mm long
Indusium	exindusiate	exindusiate

ignored this species since its original discovery probably sometime before 1880. It was not rediscovered until Timothy Flynn, in 1992, found a large and dense population growing at the base of a shaded, mossy, wet wall, just above a stream in a deep ravine, west of Pihea Trail, along the Alakai Swamp Trail. We visited the locality under his guidance in July, 1992, and can state without qualification that it is not a variety or form of *Dryopteris glabra* but instead a well-differentiated species. Furthermore, it grows to be much larger than originally described; the stipe reaches up to 25 cm, the blade to 30 cm long (Figs. 6, 7). A preliminary key is given below to separate *D. parvula* from the abundant and highly variable *D. glabra.*

Rhizome scales sparse, 5–9 mm long; blade narrowly triangular, 2–3 times as long as broad; lower stipe glabrous; color (alive) pale green; axes narrow, mostly 1–1.5 mm thick, wiry; tertiary segments mostly 1–3 mm wide except for anterior basal lobe, which is usually exaggerated; tips commonly truncate to emarginate; frond and pinna apices mostly subattenuate; sori marginal to submarginal. *D. parvula.*

Rhizome scales abundant, 8–12 mm long; blade broadly triangular, 1–2 times as long as broad; lower stipe commonly scaly; color (alive) medium green; axes broader, mostly 1.5–2.5 mm thick, stiff; tertiary segments mostly 2.5–5.0 mm wide, the anterior basal lobe conform; tips usually rounded to truncate; frond and pinna apices conform; sori submarginal to dorsal. *D. glabra.*

FIG. 5. Holotype of *Dryopteris podosora* (*W. H. Wagner 92115*, MICH).

FIG. 6. Specimen of *Dryopteris parvula* with small fronds (*W. H. Wagner 92117*, MICH).

FIG. 7. Large fronds of *Dryopteris parvula* (*W. H. Wagner 92117*, MICH).

GRAMMITIDACEAE

The two genera, *Oligadenus* and *Adenophorus*, studied by L. E. Bishop (1974) show glandular paraphyses in their sori but otherwise are quite different, as shown in the following key.

Blades simple to pinnatifid or pinnatisect; hairs non-glandular to glandular on lamina surfaces; clone formation by root proliferations (4 species, 2 nothospecies). *Oligadenus*.
Blades compound, bipinnatisect to tripinnatisect; glands appressed on laminar surfaces; clone formation by rhizomes (7 species, 2 nothospecies). *Adenophorus*.

Separation of these two genera is additionally supported by the fact that interspecific hybridization is now known within each but is absent between them. Before his premature death, Earl Bishop was working on the generic problems in Grammitidaceae; since then, the research has been continued by Alan R. Smith and Robbin C. Moran. The conclusion reached is that past generic delimitation in this family was in general too broad. For example, the former genus *Grammitis* is now considered to comprise a number of distinct, well-marked, generic elements.

A collection treated by Bishop as a variety of *Adenophorus tamariscinus* should be considered as a distinct sister species, **Adenophorus epigaeus** (L. E. Bishop) W. H. Wagner, comb. nov. [basionym: *Adenophorus tamariscinus* var. *epigaeus* L. E. Bishop, Brittonia 26: 226. 1974]. The sorus of *A. epigaeus* is dorsal (rather than apical on the pinnule). Its rhizome is long-creeping and slender (rather than short-creeping and stout); the fronds are remote (rather than close) and sublinear, and the plants are terrestrial in mosses (rather than epiphytic). Typical populations of *A. epigaeus* are known only from Kauai.

Another new combination is as follows: **Adenophorus montanus** (Hillebr.) W. H. Wagner, comb. nov. [basionym: *Polypodium tamariscinum* Kaulf. var. *montanus* Hillebr., Fl. Hawaiian Isl. 556. 1888]. This species has a short-creeping rhizome and is usually epiphytic; the sori are terminal. It is best represented in Maui but is absent from Kauai.

The first known interspecific hybrid in the genus *Adenophorus* was the recently described *A.* ×*carsonii* T. A. Ranker (1993). It involves two very different parents, A. *hymenophylloides* and *A. tripinnatifidus*, which were found growing near each other on mossy trunks of ohia lehua in the Puna District on the island of Hawaii. We herewith describe another hybrid, this one from Kauai.

Adenophorus ×**abbottiae** W. H. Wagner, hyb. nov. Fig. 8B.

Inter *A. hymenophylloides* (Fig. 8A) et *A. tamariscanum* (Fig. 8C) intermedia; frondes patentes, usque ad 7.7 cm longae; pinnae usque ad 19 paria, 0.9 cm longae, aliquantum dimidiatae, pinnula antica basali aliquantum aucta; pinnulae anticae 2–4, elongati-spatulatae; sporae parum irregulares, sine pigmento.

HOLOTYPE: Kauai, Waimea District, above Kauaikinana Stream, Pihea Trail, small patch in dense moss on fallen old ohia trunk, near parents, 28 Jul 1993, *W. H. Wagner 92120* (MICH).

The specific epithet honors Professor I. A. Abbott, noted Hawaiian botanist and phycologist, whose enthusiasm and knowledgeable help contributed much to our studies.

Adenophorus ×*abbottiae* is compared to its associated parents in table 2. Hybrids involving *A. hymenophylloides* as one parent are easily detected because of its

Table 2. Comparison of small fronds of *Adenophorus hymenophylloides* (*W. H. Wagner 92130c*), *A. ×abbottiae* (*W. H. Wagner 92130b*), and *A. tamariscinus* (*W. H. Wagner 92130a*). Vouchers are deposited at MICH.

	A. hymenophylloides	*A. ×abbottiae*	*A. tamariscinus*
Rhizome	long-creeping	creeping	upright, tufted
Leaf orientation	pendent, soft	spreading	upright, rigid
Blade	0.5–6.0×0.4–0.5 cm	2.0–6.5×0.8–1.7 cm	3.1–7.0×0.9–1.9 cm
Stipe length	0.3–0.5 cm	0.6–1.2 cm	1.0–1.9 cm
Trichomes	0.08–1.0 mm	0.2–0.4 mm	0.3–0.6 mm
Pinna length	0.2–0.3 cm	0.3–0.9 cm	0.8–1.2 cm
Number pinna pairs	up to 24	up to 19	up to 16
Shape	dimidiate	somewhat dimidiate	not dimidiate
Basal anterior pinnule	enlarged	slightly enlarged	equal to adjacent pinnule
Glands on mature axes and abaxial lamina	abundant, obliquely raised, hyaline; up to ca. 0.02 mm long	common; slightly raised; hyaline, pale tan; up to ca. 0.03 mm long	scattered; tightly appressed; golden; up to ca. 0.4 mm long
Pinnule number (anterior side of pinnae)	1–2	3–4	6–8
Pinnule shape	spatulate	elongate-spatulate	linear-oblong
Spores	normal; green	somewhat irregular; unpigmented	normal; green

unique morphology. Botanists are urged to search for less obvious hybrids involving other species pairs, especially to determine whether or not they are sterile. The plants involved were all growing within a few feet of each other, and all appeared to be somewhat dwarfed; the parents are known to reach 3–4 times the size of those described here, so the hybrid can probably also reach much larger dimensions.

POLYPODIACEAE

A. R. Smith and K. A. Wilson brought to our attention a problem involving the abundant local invasive species that we have been calling *Phymatosorus scolopendria* (L. Burm.) Pichi Sermolli. Apparently this name has been used wrongly to apply to the widespread species of the Pacific that has now spread extensively into horticulture and has become naturalized in many areas (Brownlie 1977) as it has in Hawaii, where it is perhaps now the most abundant of the local pteridophytes. The true *P. scolopendria* is of smaller stature than the Hawaiian taxon, is less widely distributed, and has not been found in Hawaii. The local species is *P. grossus* (Langsd. & Fischer) Brownlie. They may be distinguished as follows (both species, when juvenile or dwarfed, may be unlobed).

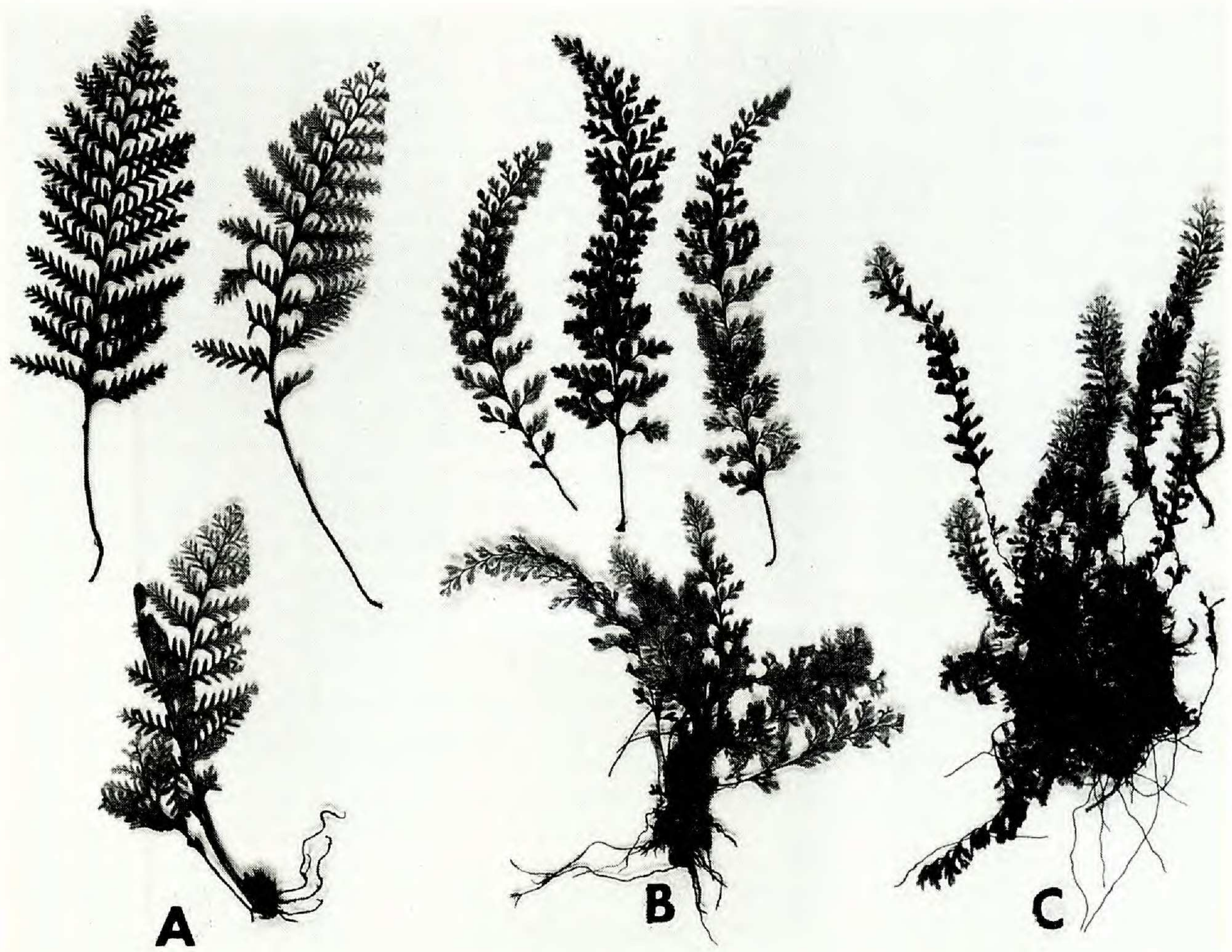

FIG. 8. *Adenophorus* ×*abbottiae* and its parent species *A. tamariscinus* and *A. hymenophylloides* (all ×0.85). A. *A. tamariscinus* (*W. H. Wagner 92125*, MICH). B. *A.* ×*abbottiae* (*W. H. Wagner 92126*, MICH). C. *A. hymenophylloides* (*W. H. Wagner 92127*, MICH).

Plants primarily terrestrial; fronds up to 70 cm tall; lateral lobes in full-sized plants 7–11 pairs, to 15 cm long, narrowing near base, rounded to somewhat pointed, leathery. *P. grossus.*
Plants primarily epiphytic; fronds up to 30 cm tall; lateral lobes in full-sized plants only 2–4 pairs, to 10 cm long, broadest at base; acuminate, chartaceous. *P. scolopendria.*

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